

# OBSERVATIONS ON THE MORPHOLOGY OF THE HUMAN TONGUE

BY SHAFIK ABD-EL-MALEK, M.B., B.Ch.

*Anatomy Department Medical Faculty, Cairo*

## CONTENTS

	PAGE
Introduction . . . . .	201
Material and methods . . . . .	201
Connective tissue frame-work of the tongue . . . . .	202
Musculature of the tongue . . . . .	204
Hypoglossal nerve and lingual artery . . . . .	208
Conclusions . . . . .	208
Explanation of Plates I and II . . . . .	209
Abbreviations . . . . .	210

## INTRODUCTION

IN another paper (1937) the musculature of the tongue in a series of animals (cat, rat, and dog) has been studied both experimentally and histologically with regard to the action as well as the attachment of the individual muscles.

In this communication it is intended to correlate our findings on animals with those present in the human tongue; for a detailed description of the architecture of the tongue is not available in the literature.

Though it is an important organ, yet it has not, so far, been given an equal share in the detailed anatomical studies allotted to other organs in the body.

The intricate interlacement of the fibres of its muscles, and the difficulty or, rather, the impossibility of complete separation of individual muscles may be admitted as a possible clue to such lack of study.

## MATERIAL AND METHODS

The observations here recorded comprise the description of both the membranous and muscular structures as well as the nervous and vascular supply of the human tongue. They were made by the help of the dissecting microscope, celloidin transverse serial sections of human tongue, and coloured celloidin injection into the vessels.

It is more helpful to deal first with the description of the stroma or connective tissue framework of the tongue as this not only separates the different muscles and includes most of the nerves and vessels of the organ, but also serves as a site of attachment for these muscles.

*The connective tissue framework of the tongue*

This includes the tunica propria of the mucous membrane, the submucous tissue, and the fibrous septa which exist in its substance.

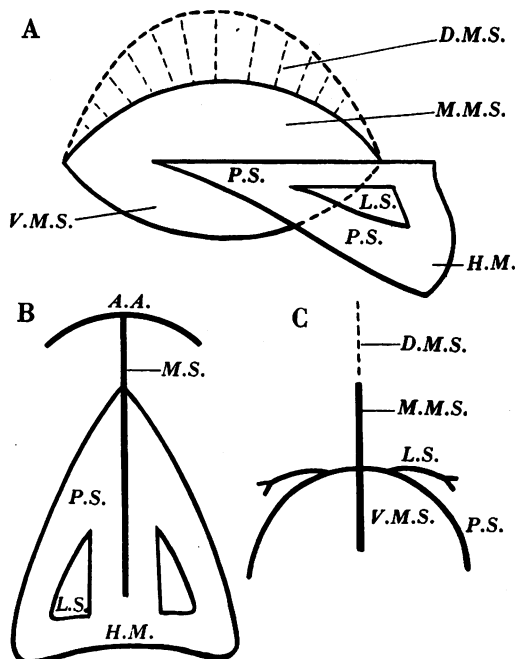
*The lamina propria* in the human tongue becomes gradually thicker and stronger on the dorsum of the tongue as it extends from its root to the tip, where it forms a cap-like thickening which is more extensive ventrally than dorsally. This condensed part of the lamina propria at the tip may be named the *anterior arch* (see Text-fig. 1 and Pl. I, figs. 1, 2). It gives attachment to the superior longitudinal muscle dorsally, and inferior longitudinal, styloglossus, some of the most anterior fibres of the hyoglossus and genioglossus muscles ventrally. The lamina propria can be seen in the ventral part of the tongue from the tip to about the attachment of the frenulum linguae.

*Septa of the tongue.* In addition to the median septum, there are two other septa in the substance of each half of the tongue, which we suggest, may be called the paramedian and lateral septa.

*The median septum* is well known both morphologically and anatomically. Its middle portion is the thickest and strongest part of the septum. It is clearly seen in the anterior two-thirds of the tongue. Its widest part is about its middle, and it decreases gradually both anteriorly and posteriorly. It gives attachment to the medial part of the transverse muscle, one on either side. The inferior or ventral part of the septum intervenes between the medial surfaces of the two genioglossi muscles, and is coterminous with them. It consists of a very loose areolar tissue with a fatty pad at its posterior part. Dorsally it is practically absent but can be detected between the two superior longitudinal muscles as a few strands in some sections (see Text-fig. 1 A, B and C, Pl. I, fig. 4 and Pl. II, figs. 5, 6).

*The paramedian septum* is the strongest septum in the substance of the tongue especially at its posterior part. It lies between the genioglossus muscle medially and the surrounding muscles both dorsally and laterally—i.e. transverse and vertical muscles dorsally, and inferior longitudinal, hyoglossus and styloglossus muscles laterally. It moulds itself on the lateral surface of the genioglossus, and consequently it is triangular in outline, with its narrow apex anteriorly reaching as far forward as and corresponding in extent with the genioglossus. Posteriorly it broadens out, assuming a more or less horizontal direction, to be attached to the hyoid bone. This part is known as the *hyoglossal membrane* (Gray's and Cunningham's *Anatomy*). Medially it is attached to the median septum at the junction of its middle and ventral parts, while its lateral surface in its posterior part gives rise to the lateral septum which will be described later. It then reaches the submucous layer and intermuscular septa of the muscles of the floor of the mouth. The lingual artery after reaching the septum is contained in its substance accompanied by veins and a very short part of the hypoglossal nerve (see Text-figs. 1 A, B and C, 2, 3 and 4, and Pl. I, figs. 3, 4 and Pl. II, figs. 5, 6).

**Lateral septum.** This is placed between the inferior longitudinal muscle medially, and hyoglossus and styloglossus muscles laterally. It is somewhat triangular in shape, and its apex is directed anteriorly, ending where the three muscles unite, while its base, which is directed posteriorly, is continuous with the posterior part of the paramedian septum of the hyoglossal membrane. Its medial border is attached to the paramedian septum whereas laterally it divides in its ventral part into two lamellae, lateral and medial, which intervene between the styloglossus, hyoglossus, and inferior longitudinal muscles respectively. In its substance lies the trunk of the lingual



Text-fig. 1. Diagram to show roughly the outline of the connective tissue framework of the tongue  
 A. The three septa and their relation to one another as seen from the left side of the tongue. The dorsal part of the median septum which is occasionally seen between the two superior longitudinal muscles is indicated by short lines. B. The three septa, the hyoglossal membrane, and the anterior arch as seen in a horizontal plane are illustrated roughly and diagrammatically. C. The septa as seen in a transverse section at the posterior third of the tongue.

artery with its dorsalis linguae branches, as well as the glossopharyngeal nerve in its medial lamella. Its lateral lamella contain in its substance the hyoglossal nerve—with its branches to styloglossus, hyoglossus and genioglossus muscles. Its venae comites and the lingual nerve are also contained in its substance (see Text-figs. 1 A, B and C, 2, 3, 4 and Pl. II, fig. 6.)

*Musculature of the tongue*

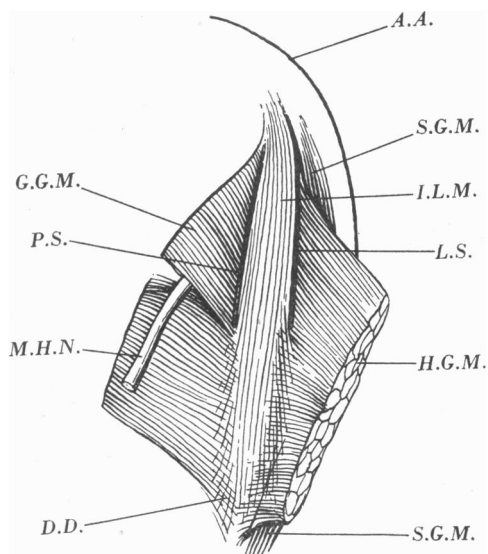
*The superior longitudinal muscle*, which is usually described as a thin stratum, is in reality only so in its peripheral parts, i.e. in its anterior, posterior and lateral parts. In the middle two-fourths of the tongue it is a bulky mass triangular in cross section, lying dorsal to the transversus and verticalis muscles (see Pl. I, figs. 3, 4). Its posterior fibres are reduced to a thin sheet which is attached to the lamina propria of the mucous membrane of the posterior third of the tongue. Some of these fibres can be traced backwards with difficulty to be attached partly to the lower and ventral part of the epiglottis and hyo-epiglottic ligament and partly to the hyoglossal membrane. The anterior fibres gradually flatten to a sheet, which is attached partly to the lamina propria on the dorsum of the tongue, and partly to the dorsal part of the anterior arch. Laterally the muscle is reduced gradually in thickness to join the longitudinal fibres of styloglossus, hyoglossus and inferior longitudinal muscles at the lateral border of the tongue. The fibres of the two muscles—one on each side—are in some localities separate, due to the interruption of some fibres of the two genioglossi muscles which may reach the lamina propria on the dorsum of the tongue either directly, or after decussation those of the opposite side (see Pl. I, figs. 3, 4, and Pl. II, figs. 5, 6, 7).

*Inferior longitudinal muscle*. This is a narrow muscle, oval in cross section, which extends between the paramedian septum and the medial lamella of the lateral septum. Posteriorly it generally possesses two attachments, i.e. medial and lateral. The medial part arises in conjunction with the most lateral and ventral fibres of genioglossus muscle—with whose fibres it decussates—from the anterior surface of the hyoid bone. Its lateral attachment is from the lateral part of the body of the hyoid bone, as well as from the root of its great cornu, together with the most medial of the decussating fibres of hyoglossus muscle (see Text-fig. 2). A few fibres in between these two attachments are occasionally seen to extend posteriorly to be attached to the stylohyoid ligament. As the muscle proceeds towards the tip of the tongue it partially rotates infero-medially. In about its middle it blends with the anterior fibres of genioglossus, hyoglossus, and styloglossus muscles, with which it forms the ventral part of the tip. All these muscles are attached to the anterior arch (see Text-figs. 2, 3).

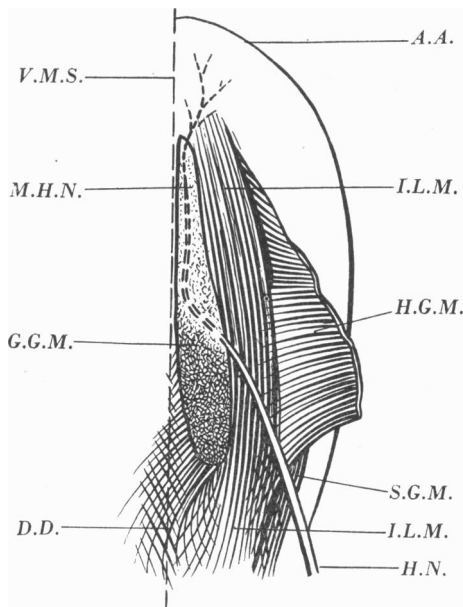
*The transverse muscle* forms a good part of the thickness of the tongue, especially in its middle. It is situated between the superior longitudinal muscle dorsally, and paramedian septum, genioglossus and inferior longitudinal muscles ventrally. It can be easily described as a series of lamellae which extend from the median septum laterally. The more superficial fibres take a dorsal direction, the deepest ones are directed ventrally. The muscle consists of two types of fibres, long and short. The former are long enough to reach the lamina propria of the mucous membrane of the side of the tongue, to which they also have their lateral attachment. The latter are the

majority of the fibres which are interrupted by the neighbouring muscles with their septa, to which they are naturally attached. All the muscular fibres decussate with those of the vertical muscle and some decussate with fibres of genioglossus muscle. The transverse muscle extends more anteriorly and posteriorly than does the vertical one (see Pl. I, figs. 3, 4 and Pl. II, fig. 5).

*The vertical muscle* consists of several bundles of fibres placed more or less in a vertical direction. They decussate intimately with the strata of the transverse muscle, thus forming together a considerable part of the central mass of



Text-fig. 2.



Text-fig. 3.

Text-fig. 2. Diagram to show the intimate relation between the posterior part of the inferior longitudinal muscle with genioglossus medially and hyoglossus muscle laterally. Anteriorly the same muscle (i.e. the inferior longitudinal muscle) interdigitates with the most anterior fibres of the genioglossus medially, and hyoglossus and styloglossus muscle laterally in forming together the anterior part of the tongue.

Text-fig. 3. Diagram illustrating the course of the hypoglossal nerve throughout its whole course in the substance of the tongue. It is seen in a dissection from its ventral aspect.

the tongue. They consist of two sets of fibres, a few long fibres which reach the lamina propria dorsally, or the submucous layer ventrally. The rest of the fibres fall short between the paramedian septum and adjacent muscular septa (see Pl. I, figs. 3, 4 and Pl. II, fig. 5).

*Genioglossus muscle.* This is an extensive muscle which constitutes the main bulk of the tongue posteriorly. It is present in all transverse and horizontal sections, and can be seen in all parasagittal sections except those situated most laterally. It arises by a short musculo-tendinous origin from the superior

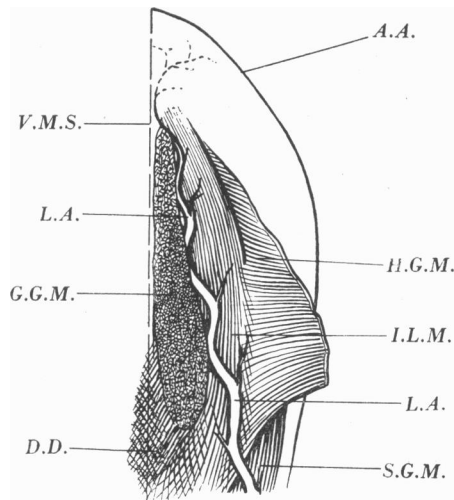
mental spine on the inner surface of the symphysis menti, and spreads dorsally in the substance of the tongue from root to tip, in a fan-shaped radiation both antero-posteriorly and medio-laterally. Its anterior fibres run in a curved antero-dorsal direction to join the anterior fibres of inferior longitudinal, hyoglossus, and styloglossus muscles, with which it is attached to the anterior arch (see Text-fig. 2). Its posterior fibres run horizontally and backwards to the root of the tongue to the anterior surface of the hyoid bone and anterior surface of the base of the epiglottis. The intermediate fibres diverge with different degrees of obliquity between the two above-mentioned parts to be attached to the ventral surface of the paramedian septum, and the lamina propria of the mucous membrane on the dorsum of the tongue.

Most of its fibres, especially those of the intermediate and posterior parts of the muscle, radiate in a medio-lateral direction in addition. The lateral fibres diverge in an outward direction. The medial fibres decussate with those of the opposite side posteriorly, whereas the anterior fibres pass nearly vertically and dorsally. The middle fibres run dorsally with different degrees of obliquity in between the above mentioned two parts. Some of the medial dorsal fibres of the same muscle interdigitate with the transverse muscle before they can escape dorsally to the mucous membrane of the dorsum of the tongue. A good number of these escaping fibres, before they reach their termination will either interdigitate with the fibres of the superior longitudinal muscle of its corresponding side, or pass in between these two muscles. Some of these latter fibres decussate with the corresponding fibres of the opposite genioglossus muscle before being attached to the lamina propria (see Pl. II, figs. 5, 6, 7). At the posterior part of the posterior third of the tongue, where the superior longitudinal muscle is reduced to a thin sheet of muscular fibres, the genioglossus interdigitates with it directly. At the same time it lies in close approximation to the dorsum of the tongue to which they both are attached (see Text-figs. 2, 3, 4, Pl. I, figs. 3, 4 and Pl. II, figs. 5, 6, 7).

*Hyoglossus muscle.* This is a quadrangular muscle in its lower two-thirds but radiates in a fan-shaped manner in its upper third. It lies between inferior longitudinal and genioglossus muscles medially, and styloglossus, mylohyoid muscles, and submaxillary gland laterally. It arises from the lateral part of the anterior surface of the body of the hyoid bone—in conjunction with the lateral fibres of the inferior longitudinal muscle as well as from the whole extent of the greater cornu. The anterior part of the muscle, i.e. that portion which arises from the body of the hyoid bone, lies superficial to the part arising from the greater cornu, and interdigitates at its origin with superficial and deep fibres of the geniohyoid.

The proximal third of the muscle consists of fibres, which, in addition to their radiation antero-posteriorly, run medially and dorsally. The anterior fibres run nearly longitudinally towards the tip of the tongue to which they are attached. Its posterior fibres, which lie under cover of styloglossus with which they decussate, radiate nearly transversely and posteriorly towards the

root of the tongue, decussating again with the lateral part of the inferior longitudinal muscle medially (see Text-figs. 2, 3, 4). The middle fibres, which run more medially and dorsally, differ in their obliquity between the anterior and posterior fibres. Both the middle and posterior fibres are partly attached to the paramedian septum and partly after decussation join the fibres of superior longitudinal muscle dorsally and transverse and genioglossus muscle ventrally (see Pl. II, figs. 5, 6, 7).



Text-fig. 4. Diagram to show the relation of the lingual artery to the lingual muscles as they are dissected from the ventral surface of the tongue. The decussation between the posterior parts of the two genioglossi is shown in the median plane.

*The styloglossus muscle* arises from the anterior and lateral surface of the styloid process near its apex, and from the proximal part of the stylomandibular ligament. It is flattened medio-laterally to begin with. As it runs downwards and forwards towards the tip of the tongue, it divides into two parts, lower and upper. The former is the shorter and smaller of the two and ends by decussating superficially with the lateral surface of the hyoglossus muscle. The latter is the larger part and proceeds towards the tip of the tongue where its deep fibres interdigitate with the same muscle. At the anterior border of hyoglossus the muscle is enlarged in a ventral direction and winds round the lateral and ventral parts of the tongue until it gains its inferior surface (i.e. its inferior border becomes medial and its medial surface now looks dorsally). It then insinuates itself among the anterior fibres of genioglossus, hyoglossus and inferior longitudinal muscles, joining together to be attached to the anterior arch (see Text-fig. 2 and Pl. II, figs. 5, 6, 7).

*Hypoglossal nerve*

In the submaxillary region the hypoglossal nerve passes forwards, first between the submaxillary gland and hyoglossus muscle, and then between mylohyoid and hyoglossus muscles, where it gives medial branches to geniohyoid, lateral ones to the deep surface of styloglossus and superficial surface of hyoglossus, in addition to medial twigs supplied to genioglossus.

At the anterior border of hyoglossus, the nerve trunk winds upwards and medially round it, supplying several branches to its deep surface. The nerve then divides into two divisions. The smaller, which we may call the lateral division, runs in between hyoglossus, styloglossus and inferior longitudinal muscles supplying them with several fibres. The larger medial division crosses beneath the inferior longitudinal muscle, and sometimes passes through its lower fibres. It traverses the paramedian septum to gain the lateral surface of the genioglossus muscle, and follows a sinuous oblique course dorsally, medially and forwards through nearly the whole thickness of the muscle. It then reverses its course, running laterally upwards and anteriorly and distributing several twigs both medially and laterally to the genioglossus; then dorsally to the transverse, vertical and superior longitudinal muscle. Some nerve fibres were traced in company with their corresponding branches of the lingual artery along the fibres of the genioglossus to the superior longitudinal muscle. Some others were seen to supply the transverse and verticalis before reaching the superior muscle. Just before the tip the nerve terminates by giving several end branches to radiate in an arciform manner, paramedially, to the adjacent muscles (see Text-fig. 2, 3, and Pl. I, figs. 3, 4, and Pl. II, figs. 5, 6).

*Lingual artery*

As the lingual artery appears from the anterior margin of the hyoglossus muscle, it gives its sublingual branch. It then proceeds in a very sinuous course anteriorly, upwards, and slightly medially in the substance of the paramedian septum between the genioglossus muscle medially and inferior longitudinal muscle laterally in its course to reach the dorsum of the tongue. It forms about four to five arches dorso-ventrally, from which arteries are distributed medially, laterally and dorsally. Near the tip of the tongue it divides into its two terminal branches, medial and lateral. The former is a short and sinuous branch which runs towards the septum, anastomosing with the corresponding branch of the opposite side. The latter forms an arch to furnish its terminal twigs, some of which anastomose with its sublingual branch (see Text-fig. 4).

## CONCLUSIONS

1. Besides the median septum, two other septa are demonstrated in the substance of each half of the tongue. They not only separate the different surrounding muscles, but also serve as a site of attachment for them. In

addition, they contain in their substance the trunks of the lingual vessels and nerves as well as parts of their main branches.

2. An anterior arch is described at the tip of the tongue for the attachment of the superior longitudinal muscle dorsally, and the inferior longitudinal, hyoglossus, styloglossus and genioglossus muscles ventrally.

3. The inferior longitudinal muscle has a double bony attachment to the hyoid bone in conjunction with genioglossus and hyoglossus.

4. The superior longitudinal muscle, which is demonstrated to be a bulky muscle, triangular in cross section, is indirectly attached to the hyoid bone.

5. The intralingual course of the lingual artery and the hypoglossal nerve are described as well as their main branches.

#### ACKNOWLEDGEMENTS

My sincere acknowledgements are due to Prof. D. E. Derry for his guidance and criticism, and to Dr Amin Bey and Dr N. Fahmy for their helpful advice. I am indebted to Mr N. Strekolovsky, the Faculty artist, for the drawings.

#### EXPLANATION OF PLATES I AND II

##### PLATE I

- Fig. 1. Microphotograph from a transverse section of human tongue at its tip, showing a dense mass of fibrous tissue forming a cap which covers the tip of the tongue both dorsally and ventrally and into which the longitudinal muscle fibres are attached.
- Fig. 2. Microphotograph from a horizontal section at the tip of the tongue showing in a horizontal plane the thickness of the anterior arch which gives attachment to the longitudinal muscle fibres.
- Fig. 3. Microphotograph from a transverse section at the anterior fourth of the human tongue. The section is mainly of longitudinal muscle fibres surrounding a narrow zone of transversely running fibres of the transverse muscle with the beginning of the middle part of the median septum.
- Fig. 4. Microphotograph from a transverse section through the anterior third of the tongue. The transverse muscle, interdigitating with the vertical muscle, forms the central part of the tongue. The middle part of the median septum is seen to give attachment to the transverse muscle. No septum is seen between the two superior longitudinal muscles. The paramedian septum lies between the genioglossus muscle and inferior longitudinal muscle.

##### PLATE II

- Fig. 5. Microphotograph from a transverse section about the middle of the tongue. The transverse and vertical muscles form together about the middle third of the substance of the tongue. The median and paramedian septa are seen with the structures they contain. The styloglossus cannot be distinguished from the hyoglossus. The inferior longitudinal muscle is seen partially blending with the latter two muscles, but is separated from the genioglossus muscle by the paramedian septum.
- Fig. 6. Microphotograph from a transverse section through the posterior third of the tongue. The ventral part of the median septum, containing the pad of fat, is seen at its maximum extent. The genioglossus muscle occupies more than half of the substance of the tongue. The paramedian septum separates the muscle from the inferior longitudinal muscle which can be seen only medially and ventrally. The hyoglossus muscle can be seen with the two laminae of the lateral septum both medially and laterally. The superior longitudinal muscle is reduced to a sheet which is interrupted by several bundles of the genioglossus muscle.

Fig. 7. Microphotograph from a transverse section through the tongue at the level of the hyoid bone. The medial decussating fibres of the two genioglossi muscles are clearly seen. Superior longitudinal muscle is further reduced to a few longitudinal bundles scattered among the fibres of the genioglossus muscle. The hyoglossus muscle is seen in relation to the greater cornu of the hyoid bone. The lingual artery lies deep to it, whereas the hypoglossal nerve lies laterally. The styloglossus muscle is situated in the upper lateral angle of the section, interlacing with the hyoglossus muscle. Sections of the body as well as the great cornu of the hyoid bone are seen in the ventral part of the section.

#### ABBREVIATIONS

<i>H.N.</i>	Hypoglossal nerve.	<i>A.A.</i>	Anterior arch.
<i>M.H.N.</i>	Medial division of the hypoglossal nerve.	<i>M.S.</i>	Median septum.
<i>L.H.N.</i>	Lateral division of the hypoglossal nerve.	<i>V.M.S.</i>	Ventral part of the median septum.
<i>L.A.</i>	Lingual artery.	<i>M.M.S.</i>	Middle part of the median septum.
<i>S.A.</i>	Sublingual artery.	<i>D.M.S.</i>	Dorsal part of the median septum.
<i>S.L.M.</i>	Superior longitudinal muscle.	<i>P.S.</i>	Paramedian septum.
<i>I.L.M.</i>	Inferior longitudinal muscle.	<i>L.S.</i>	Lateral septum.
<i>T.M.</i>	Transverse muscle.	<i>H.M.</i>	Hyoglossus membrane.
<i>V.M.</i>	Vertical muscle.	<i>P.T.</i>	Palatine tonsil.
<i>G.G.M.</i>	Genioglossus muscle.	<i>P.F.</i>	Pad of fat.
<i>H.G.M.</i>	Hyoglossus muscle.	<i>M.G.</i>	Mucous glands.
<i>S.G.M.</i>	Styloglossus muscle.	<i>S.G.</i>	Serous glands.
<i>G.H.M.</i>	Geniohyoid muscle.	<i>L.T.</i>	Lymphoid tissue.
		<i>D.</i>	Decussation.

Fig. 1.

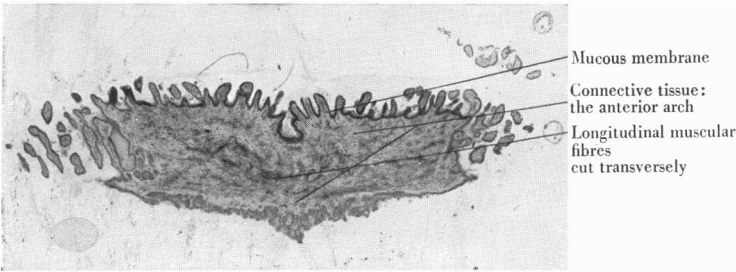


Fig. 2.

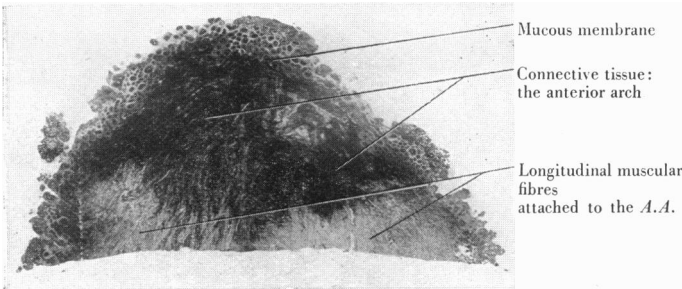


Fig. 3.

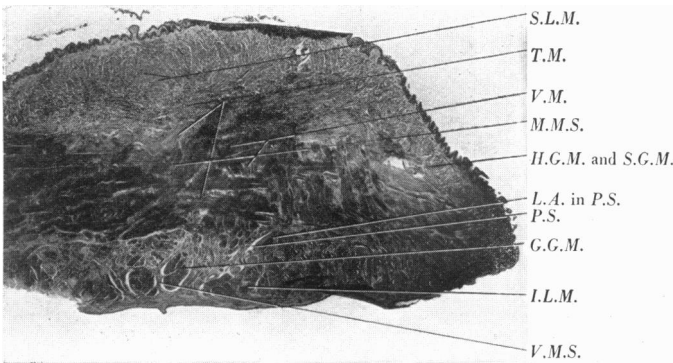
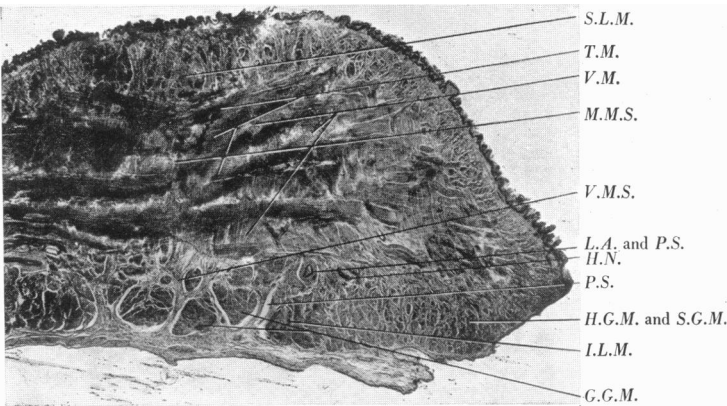
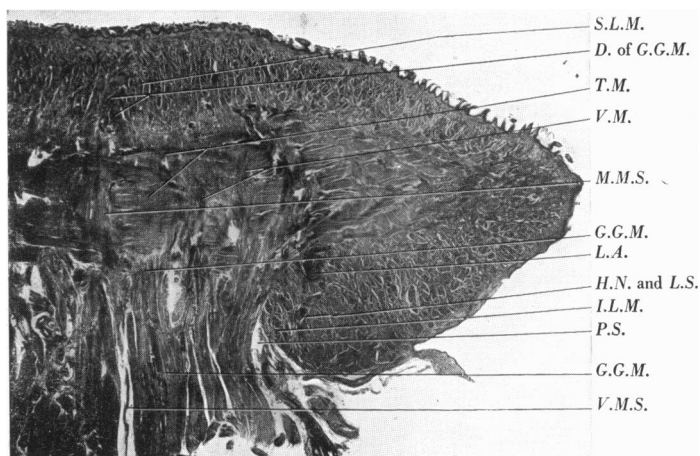


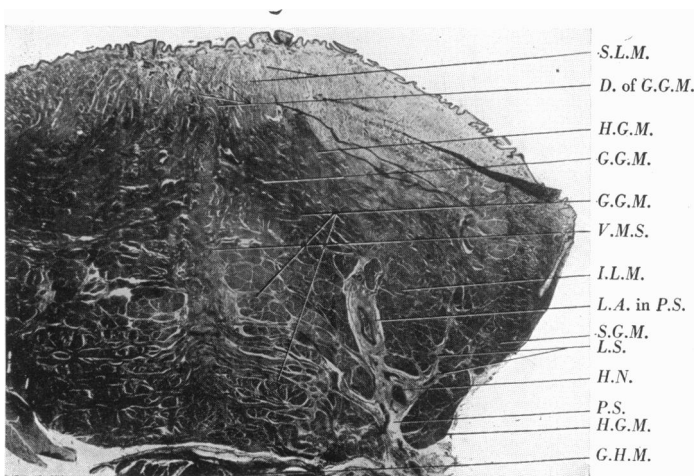
Fig. 4.



**Fig. 5.**



**Fig. 6.**



**Fig. 7.**

